2005 WASHINGTON STATE INTEGRATED KNOTWEED MANAGEMENT PLAN

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Table of Contents

INTRODUCTION

Areas of Concern

Knotweed can invade and thrive in a variety of habitats, but in particular this alien species poses a significant threat to large swaths of riparian areas in Washington State. Certain riparian areas naturally exhibit poor soil characteristics that inhibit native plant growth and most native plant species are not well adapted to colonize these landscapes. Knotweed has evolved characteristics that aid the plant in exploiting riparian areas with poor soil and rapidly colonizing a stream or river systems once a population gains a foothold. The most problematic knotweed characteristic in the invasion of riparian areas is the range of reproductive mechanisms that plant has available. Knotweed reproduces through seeds, rhizomes, and sprouting from stem pieces. All of the knotweed reproductive pathways take advantage of the natural high water regimes of Washington State rivers, thus transporting knotweed infestations to new locations.

Characteristics of Washington State Riparian Areas

A riparian area is defined as the landscape and vegetation adjacent to a stream or lake that has a direct effect on the stream. Riparian areas are essential to maintaining the water quality of streams and rivers by acting as filters that remove sedimentation and toxins from surface waters before they reach flowing water. These riparian areas include woodlands, vegetation, and floodplains. The high water table in riparian areas creates unique soil conditions that generate plant communities that are distinct from upland habitats and the diversity of water systems in Washington State forms a variety of habitats that support a wide assortment of species.

Riparian areas act as natural migration and dispersion corridors for wildlife. Between 80 to 90% of Washington wildlife utilize riparian areas during some life stage. These areas also are important to the migration and fresh water life cycles of anadromous fish native to the northwest.

Anandramous fish have evolved to best survive in the conditions created by healthy riparian areas. Today, most of the riparian areas in Washington State, if not already infested with knotweed species, face wide scale invasion by this species.

Knotweed Characteristics

This management plan pertains to the Japanese, giant, Bohemian and Himalayan knotweed. These plants, members of the buckwheat family (Polygonaceae), are native to Asia. Common names are elephant ear bamboo, Mexican bamboo, and fleeceflower. The plants exhibit hollow (untrue for the Himalayan variety), upright, bamboo-like stems growing to 1-5 meters. Knotweeds exhibit a variety of leaf shapes that differ by variety, from an elongate triangle to heart shaped. The stems are often reddish or red speckled. Young stems look similar to red asparagus. The small white or greenish flowers form in July and August and grow in dense clusters from the leaf joints. Though it may die back to the ground after a hard frost, the stems

may persist through the winter as bare, reddish brown stalks. A hybrid can show a combination of the parent leaf shapes.

For the purpose of ease of reading, this paper will label all four species under the general title of knotweed.

Ecological Threat

Knotweed, listed as a Class-B noxious weeds on Washington State's Noxious Weed List, is a perennial that can grow from seeds, rhizomes or stem pieces. In Washington State, the weed colonizes both upland and riparian areas. This plant is of specific concern in riparian areas as seasonal flood events expedite the spread of the species by washing stem fragments downstream to colonize more area. Each node of a stem can resprout to form an adult plant. Previously, adult plants were thought to send rhizomes out to a maximum of 25 feet, however, current field observations indicate that can the rhizomes can reach much further.

Knotweed adapted to inhabit the harsh environment found on the slopes of volcanoes with very poor soil characteristics. These characteristics are reproduced in the sand and gravel environments of Pacific Northwest streams. In many of these areas, knotweed is able to grow without competition from native plants because other species are unable to grow in such harsh conditions. Knotweed's success as a colonizer also gives the species a competitive edge over natives in less harsh areas of riparian zones. Knotweed emerges early in the season and grows quickly, shading out lesser species with its large leaves.

Knotweed is an aggressive colonizer that displaces plants and animals historically associated with Washington State riparian areas. Many species of mature shrubs are shaded out by the taller knotweed and even some tree species, such as alder, exhibit smaller populations in heavily infested areas. Knotweed species have long been thought of as sterile, but this has come into question in recent years. Bohemian knotweed, the hybrid species, produces viable seeds that will quicken the spread along riparian areas via seed dispersal in the water column.

Knotweed colonization poses the threat of decreasing biodiversity and the disrupting the food chain by reducing habitat available for species that depend on riparian areas. Several research projects currently underway are investigating detrimental effects of knotweed on salmonid species.

Property values may also diminish as river views may be blocked and river access limited. Maintenance costs to landowners may increase, and unknowing landowners that cut plants that are then allowed to float downstream can increase spread. Recreational opportunities are also threatened by decreased accessibility to streambanks, and may also contribute to spread when knotweed patches are knocked down during passage and the plant parts subsequently washed downstream.

CURRENT EXTENT OF KNOTWEED INFESTATION IN WASHINGTON STATE

Currently, the majority of known knotweed infestations are on the westside of the Cascades. Eastside infestations are limited and need to be considered as a priority, because the small infestations allow for the extirpation of entire populations that threaten to invade expansive areas. The total extent of the infestation in western Washington is currently unknown as the emphasis on the threat knotweed species pose to Washington waterways and on the need to initiate control programs is relatively recent.

Another reason for the lack of knowledge on the extent of the infestation is the nature of spread of knotweed. The main movement method of the plant is through vegetative regrowth of plant parts that are washed downstream during high water events. Entire sites may be stripped of knotweed and those plants may set roots to subsequently start many new infestations downstream. These new infestations then spread rapidly through rhizomal growth that can extend underground to 25 feet or more during one growing season.

WASHINGTON STATE KNOTWEED MANAGEMENT STRATEGY

Purpose and Objectives of Knotweed Eradication Program

The goal of knotweed management in Washington State is to preserve and protect the integrity of riparian ecosystems from the encroachment of knotweed species. An effective weed management program will restore native riparian areas and ensure that quality riparian habitats are available for all species. The program will also preserve natural resources for recreation, fisheries, and cultural resources of significance to Native Americans.

The objectives for knotweed control in Washington State include:

- Riparian restoration through the removal of knotweed from riparian areas, enhancing public access, and salmon and wildlife habitat.

- Monitor results of all control site efficacy and re-growth seasonally. Modify and improve future control methods based on this information.

- Retreat sites if necessary.

- Treat each river system downstream from the headwaters to prevent reinfestation of treated areas thereby building on the successes of each previous treatment season.

Using Integrated Weed Management

Use of Integrated Weed Management (IWM), as defined in Section 3.6.1 of the *Final Noxious Emergent Plant Management Environmental Impact Statement of 1993*, allows selection from treatment methods listed below to match the management requirements of each specific site. Treatment methods are chosen to maximize efficacy and to minimize negative environmental, economic and social impacts. At individual sites, they can also be used in combinations, allowing for variation in environmental sensitivity within the sites to be appropriately addressed.

Hand Pulling/Hand Digging/Tilling: Hand pulling knotweed is an option only if the soil is soft, the plants are young, there are only a few plants, and the effort is persistent and ongoing for an extended time period. Once the plants have developed extensive roots and rhizomes they will be impossible to completely remove. Any rhizomes remaining in the soil will produce new plants at each node. Also any knotweed vegetation must be disposed of in such a manner so it cannot take root, because even small plant fragments can root if they are in moist soil.

In soft soil or sand, the plant should be pulled up by the root crown, trying to remove as much of the rhizomes as possible. About a week after this effort, search for and pull up any resprouting plants and as much of the rhizome as possible. Search for resprouts at least 25 feet around the location of the original plant. Continue this effort until frost and then start again in the spring. Three years of consistent effort can be required to eradicate a small patch of plants using this method.

Plants and rhizomes of knotweed might possibly also be dug out, but this is a slow labor intensive process and probably not practical with anything more than a very small infestation of several plants. Tilling also produces many resprouts but could be used in combination with a hand pulling effort. Neither of these activities should be used extensively in riparian areas.

Cutting/Mowing: It is possible to eradicate small patches of knotweed with repeated and persistent cutting of the plants. The patches must be mowed or cut twice a month between April and August and then at monthly intervals until frost. Like pulling/digging this effort will need to be maintained for at least two to three years. Using a hand pruner, lopper, or brushcutter, the stalks should be cut as close to the ground as possible. The regrowth should not be allowed to exceed six inches in height before the stalks are again cut to the ground. The cut stalks need to be stacked where they will dry out and not root (away from moist ground). When using a brushcutter, it needs to be ensured that scattered plant parts do not land in moist areas where they can take root.

Herbicides Treatment: Glyphosate brands with aquatic labels have been used to effectively control knotweed in aquatic situations. Glyphosate is not selective and will damage most other plant species. When desirable vegetation is nearby, applicators should try to minimize its loss by focusing their application just on the target plants.

Habitat®, an aquatic labeled formulation of imazapyr has been approved for use in Washington in 2004. Because imazapyr is known to translocate readily to rhizomes, this non-selective

herbicide will likely play a role in knotweed management. There is information showing highly effective results obtained with a glyphosate/imazapyr mixture.

Renovate®, an aquatic labeled formulation of triclopyr has been approved for use in Washington in 2004. Triclopyr will control Japanese knotweed, but there are no specific control recommendations for Japanese knotweed on the Renovate® label. For successful translocation to occur, the herbicide should be used at the lowest effective concentration in order to avoid damaging the above ground tissues of the plant before the herbicide is well dispersed in the root system. Triclopyr (Garlon 3a) at five percent solution appears to give good top-kill on Japanese knotweed but results in mediocre long-term control on large patches. However, there are reports of successful control using triclopyr at rates as low as ¾ percent in high volume application.

Foliar application, using backpack sprayers or similar methods, is more efficient on larger monoculture stands of more than a few plants to several acres in size. To achieve the best chance of complete kill, apply herbicide in the spring to plants that are less than 4 feet. The plants need to be large enough to ensure that there is adequate leaf surface. Spray to wet and try to avoid dripping of the herbicide from the leaves and to minimize off target damage. Although the late bud stage of growth is considered to be the most effective time for herbicide application for knotweed species, waiting that long also means dealing with a huge plant.

Cut stem application can result in up to 95 percent mortality. In the summer or fall, cut each stem within one to three joints of their base (internodes). Add herbicide into the exposed hollow stem cavity following label recommendations. Cut stem application is labor-intensive, both to cut each stem and to apply herbicide, but it will assure that the herbicide is only applied to target weeds and not to other desirable vegetation. Dispose of the cut stems away from moist environments where they might take root. There is need to apply with care to avoid causing off target damage from the undiluted herbicide.

The stem injection application instrument injects a metered dosage of glyphosate into a stem while poking a hole in the other side of the stem. The second hole allows any liquid in the stem to escape as the glyphosate is injected. The plant takes up the herbicide within 20 minutes of injection. Since each stem appears to be supported by a separate rhizome, each separate stem must be injected to kill an entire stand. For large stands, injection can be conducted several times working towards the center of the stand or injection can be used to treat regrowth after a foliar treatment. Although, as with the cut stem method, injecting is labor intensive, 100 percent kill has been reported. Care is also needed with this treatment to avoid off target impacts.

Covering: There have been anecdotal reports of successful control of small patches of knotweed using a combination of cutting, hand pulling, and/or tilling, followed by covering. After cutting the plants down to ground level, the area needs to be covered with several layers of black plastic, cardboard, or landscape fiber. The area of coverage should be expanded to at least 25 feet or more around the outside of the plant and check at intervals to make sure that shoots are not coming up outside of the cover or through the cover. The cover needs to be left in place for at least one full year and probably longer. Site inspections to locate and remove regrowth or seedlings should be conducted on a frequent basis. Some of the areas treated with covering have even exhibited rhizomal growth surrounding the covering during the following growing season.

Mechanical Removal: This technique can be used on single plants or larger infestations, but will be costly to contract for or purchase suitable equipment. All top vegetation and rhizomes need to be removed to at least 50 feet from each plant. It is critical to remove all vegetation including rhizomes and stems, because they will generate new plants from each node if they remain in contact with moist soil. Once this operation is complete, revegetation with appropriate native plants that cast heavy shade on the ground should occur. Plan for at least annual monitoring for new plants from missed plant parts and seed, and treat or remove immediately. This treatment option is not recommended in riparian areas because of runoff to streams created during the removal process.

Grazing: Goats will eat most plants down to stems that are too woody for ingestion. Grazing will not eradicate knotweed and the plant will continue to grow once grazing ceases. Grazing may be suitable for quarter acre and larger infestations when the plants have put up enough top growth to support the livestock. The animals need to be contained in the area by fencing, and when all weed growth has been grazed, removed to allow for the development of new shoots. When growth becomes abundant enough to support grazing again, the animals should be allowed to graze it a second time. This cycle should continue through two consecutive growing seasons at a minimum. This may kill some plants and greatly weaken others, as well as, breakup the dense mat of rhizomes extending out from each plant. Grazing could be followed, by herbicide application to kill existing regrowth, before revegetating with suitable native plants to create dense shade. At least annual monitoring is required to control regrowth from seed, rhizomes or broken off stems.

Burning: Knotweed is not killed or much impacted by burning. However, burning removes dense herbaceous litter and opens access to dense stands for other treatments, such as herbicide application or grazing. Burning should be considered only for stands of one half acre or larger and planned carefully relative to surrounding features and improvements.

Bio-control: A number of insects are found to utilize knotweed in its native range and fungus infections exhibit some impacts. A combination of fungus and insects appear to keep knotweed species under control in Japan. Work on biological controls is in the early stages of survey. Some surveys for native insect enemies were started in the northeastern U.S. in 2000. At this point, much work needs to be done on biological control for before it becomes permitted as a control option.

Unlike other alternatives, IWM includes a systematic process for establishing management goals and prioritizing activities on the basis of infestation type; prevention of introduction or infestation growth; determination of abundance thresholds used to dictate when management activities are required; infestation monitoring; and public involvement. The preferred alternative, IWM, will be the guiding principle for knotweed control, containment, reduction, and eradication efforts.

Public Notification

WSDA and participating agencies will conduct a public notification campaign before treatments start each spring. The campaign will consist of several components. First, the participating agencies will send a mass mailing consisting of informational letters and fact sheets to all streamside residents of areas to be treated. Also, participating agencies will post public notices and notify adjacent owners where treatments will take place. The notices will be posted at any public access point within one half mile of any treatment site. Public access points are listed in the Public Boating Facilities in Washington State Second Edition - 1988, published by the Washington State Parks and Recreation Commission Boating Safety Program.

CONCLUSION

Cooperation and coordination between agencies will be the essential element for learning more about knotweed and improving the effectiveness of knotweed control and eradication on a large scale. Coordinating knotweed management efforts on a regional basis will contribute a great deal towards the facilitation of the statewide knotweed control program. The strategies employed each season will produce realistic cost and efficacy estimates to guide the choice of future treatment options. The lessons learned in each subsequent season will allow for the adjustment of knotweed control so that the most current techniques are used in the most efficient manner possible. In addition, the agencies' cooperative work across ownership boundaries will continue to serve as a model to address knotweed management on a landscape level, one that transcends traditional weed and resource management boundaries.